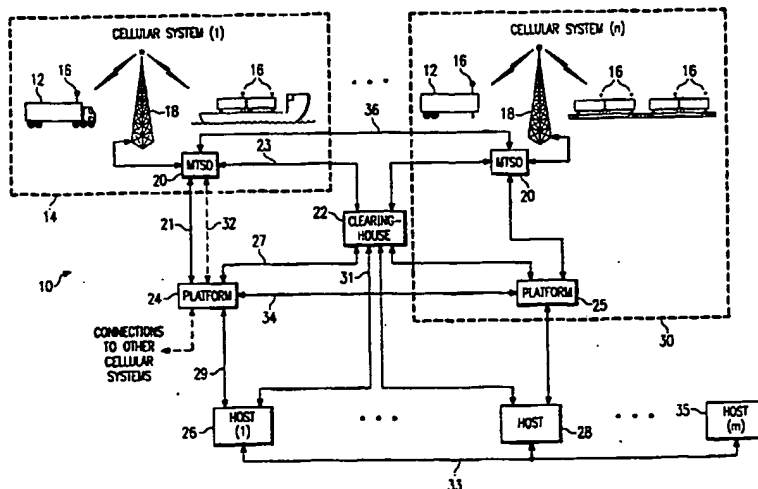# INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: DATA MESSAGING IN A COMMUNICATIONS NETWORK

(57) Abstract

A messaging unit (16) equipped with a cellular transceiver (38) is attached to a truck trailer (12) located within a communications network (10). The messaging unit (16) generates a data message in response to the occurrence of a reporting event. Upon generation of a data message, the cellular transceiver (38) transmits the data message over the network (10) via voice or data channels. The data message is received at an MTSO (20) and then routed to a platform (24), a clearinghouse (22), or the platform (24) through the clearinghouse (22). The data message stored at the platform (24) or the clearinghouse (22) is accessed by a host (26). A data message may be sent over a voice channel of the network (10) subject to a handshake protocol between the messaging unit (16) and the platform (24). Data messages may also be sent over a data channel of the network (10) by altering the mobile identification number (MIN) or electronic serial number (ESN) of the cellular transceiver (38). Furthermore, data messages may be sent over a data channel of the network (10) by issuing a feature request with appended data digits.

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DATA MESSAGING IN A COMMUNICATIONS NETWORK

TECHNICAL FIELD OF THE INVENTION

This invention relates generally to the field of
telecommunications, and more particularly to data
5   messaging in a communications network.

BACKGROUND OF THE INVENTION

The proliferation of sophisticated communications systems has resulted in developments in mobile communications and in particular mobile data messaging.

5 Data messaging collectively refers to the transfer of information over voice or data channels of a communications network. One application of data messaging is the monitoring of a group of items by causing the items to send data messages to a remote

10 location in response to a recognized reporting event. For example, a truck trailer monitoring system may use data messaging to collect information on the current position and status of a fleet of truck trailers.

15 A network of cellular telephone systems is a suitable conduit for such data messaging, especially if the monitored items are mobile, such as people, vehicles, or cargo containers. However, the cost of using traditional cellular communication is prohibitive, both

20 in terms of chargeable air time and roamer fees.

Another problem with using traditional cellular networks for data messaging is that the fragmentation of cellular service providers results in disintegrated

25 monitoring and control of cellular air traffic, which often contributes to fraudulent use of the cellular telephone network. Increasing incidents of roamer fraud adds significantly to the cost of cellular air time, especially for nation-wide users of the cellular

30 telephone network. To combat these problems, cellular service providers are implementing authorization and verification procedures for validating roaming customers.

Therefore, a need has arisen for a communications network that handles a high volume of data messaging by exploiting the functionality of existing cellular telecommunications equipment, while reducing

5   opportunities for fraud. In particular, a need has arisen for data messaging to monitor the position and status of a national fleet of truck trailers in the most cost effective and reliable manner.

SUMMARY OF THE INVENTION

In accordance with the teachings of the invention, a
method and apparatus for data messaging in a
communications network is provided which substantially
eliminate or reduce disadvantages and problems associated
with prior art data messaging systems. Furthermore, data
messaging in a cellular telephone network to monitor the
location and status information of a fleet of truck
trailers substantially eliminates or reduces
disadvantages and problems associated with prior art
truck trailer monitoring systems.

In accordance with one aspect of the invention, a
system for communicating data messages over a cellular
telephone network contains a plurality of messaging
units. Each messaging unit includes a processor that
generates a data message upon the occurrence of a
reporting event. Each messaging unit also contains a
cellular transmitter that transmits the data message over
the cellular telephone network. A platform coupled to
the cellular telephone network receives data messages
transmitted by the messaging units and stores the data
messages in a storage device. A host coupled to the
platform accesses data messages stored by the platform.

In accordance with another aspect of the invention,
a messaging unit attached to a mobile item to be
monitored sends data messages over a data channel of a
cellular telephone network. The messaging unit includes
a sensor located on the mobile item that generates
information on the mobile item. A processor is coupled
to the sensor and receives the information from the
sensor. The processor generates a data message
containing the information upon the occurrence of a

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reporting event. A cellular transmitter coupled to the processor transmits the data message over a data channel of the cellular telephone network.

5   In accordance with another aspect of the invention, a method for data messaging over a cellular telephone network encodes an identifier of the cellular transmitter. Data messaging is initiated upon the occurrence of a reporting event. The identifier of the

10   cellular transmitter is encoded with information on the reporting event. The encoded identifier is then transmitted through the cellular telephone network using the cellular transmitter and received at a remote location.

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          In accordance with another aspect of the invention, a method for data messaging over a cellular telephone network issues a feature request. Data messaging is initiated upon the occurrence of a reporting event. A

20   feature request is then generated and data digits representing information on the reporting event are appended to the feature request. The feature request and data digits are then transmitted through the cellular telephone network and received at a remote location.

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          An important technical advantage of the invention is that data messages sent to or received from the messaging units over a voice channel of a cellular telephone network are subject to a verification procedure, thereby

30   allowing for multiple levels of fraud protection. In particular, a handshake protocol is required when a data message is directed to or received from one of the messaging units, thereby preventing theft of cellular air time through roamer fraud.

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Another important advantage of the invention is that
messaging units can send data messages over a data
channel of a cellular telephone network by altering the
mobile identification number (MIN) or electronic serial
5   number (ESN) of the cellular transmitter. By altering
these cellular transmitter identifiers, the messaging
unit can send information over existing cellular
telecommunications equipment without opening a voice
channel or dedicated data channel.
10

Still another important advantage of the invention
is that messaging units can send data messages over a
data channel of a cellular telephone network by issuing a
feature request with appended data digits. The feature
15   request is then routed through a data channel of a
cellular telephone network to a remote data message
gathering location.

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BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings, wherein:

5

FIGURE 1 is a block diagram of a communications network for communicating a variety of data messages in accordance with the teachings of the invention;

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FIGURE 2 is a block diagram of a messaging unit operating within the communications network for sending and receiving a variety of data messages in accordance with the teachings of the invention;

15

FIGURE 3 is a flow diagram for sending a data message over a voice channel of the communications network using a modem handshake protocol in accordance with the teachings of the invention; and

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FIGURE 4 is a flow diagram for sending a data message over a data channel of the communications network in accordance with the teachings of the invention.

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DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 is a block diagram of a communications network 10. Located within cellular system 14 of network 10 is a truck trailer 12 carried by a cab, barge, train,

5   or other suitable transportation system. It should be understood that the invention contemplates data messaging from any group of cargo containers, vehicles, persons, and other items whose location and status information are to be monitored.

10   Network 10 may be a cellular telephone network, but it may also be another type of communications system, such as a specialized mobile radio (SMR) system, a personal communication services (PCS) system, or any other suitable communications system. Furthermore,

15   network 10 may be comprised of land-based transmission towers, space-based satellite transponders, or a combination of communications hardware in space or on land. Transmissions over network 10 may be analog or digital without departing from the scope of the

20   invention.

Truck trailer 12 is equipped with a messaging unit 16, which contains a cellular transceiver for sending and receiving data messages. The design of messaging unit 16 is discussed in detail with reference to FIGURE 2.

25   Cellular system 14 includes a transmission tower 18 and a mobile telecommunications switching office (MTSO) 20 coupled to the transmission tower 18. It should be understood that each cellular system 14 may comprise a plurality of transmission towers and a plurality of

30   MTSOs.

MTSO 20 switches calls to and from the cellular system 14 and a land-based telecommunications system (not shown). MTSO 20 is also coupled to clearinghouse 22, which provides call information to MTSO 20 through data

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link 23. For example, MTSO 20 can be configured to
connect calls only if clearinghouse 22 provides, for
example, validation information indicating that the
cellular phone involved has good credit or is authorized
5   to make calls. Clearinghouse 22 may also maintain other
information, such as "roaming" phones' present locations
and home systems. In existing cellular systems,
companies such as GTE/TSI, EDS, and McCaw provide the
clearinghouse function.

10   MTSO 20 is coupled to a telecommunications platform
("platform") 24 through a voice/data link 21. Pending
U.S. Patent Application Serial No. 08/095,166, referenced
above, describes in detail the construction and operation
of the platform 24. Clearinghouse 22 is also coupled to
15   platform 24 through data link 27 to provide platform 24
with information generated by clearinghouse 22. In turn,
platform 24 is coupled to host 26 through voice/data link
29. Platform 24 may be coupled to any other host, such
as host 28, through a similar voice/data link.
20   Alternatively, hosts 26 and 28 may receive call
information directly from clearinghouse 22 over data
link 31.

     Hosts 26 and 28 are shown for clarity, but it should
be understood that many other hosts may be similarly
25   coupled to platform 24, other platforms, other hosts, or
clearinghouse 22. Link 33 between host 26 and host 28
allows hosts to exchange information. Host 35 may be
connected to host 28 via link 33, such that host 35
receives information solely from host 28. In such a
30   manner, designated hosts in network 10 act as central
hosts to receive data messages and distribute these
messages to other hosts.

     FIGURE 1 illustrates another cellular system 30,
which includes a separate transmission tower 18 and MTSO

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20. Within the operating region of cellular system 30
are truck trailers 12 equipped with messaging units 16.
A platform 25 may be associated with cellular system 30,
illustrating that the platform functions can be performed
5   at distributed locations throughout network 10. However,
platform 24 may perform all platform functions for all
cellular systems. Moreover, as shown in FIGURE 1,
platform 24 may be coupled to one or more cellular
systems. For example, platform 24 may be coupled to all
10   of the east coast cellular systems. Likewise, platform 25
is a distributed platform, and is associated with and
part of a particular cellular system. Platform 25, like
platform 24, is coupled to a host, such as host 28.
Dashed line 32 indicates a link between MTSO 20 and
15   platform 24. With a proposed standard (IS41, revision
A), validation of a user can be performed prior to the
placing of cellular calls. For example, at power up or
upon first entry into a particular cellular system, a
cellular transceiver can issue identifiers to MTSO 20 for
20   pre-validation. Alternatively, MTSO 20 can poll a
cellular transceiver to provide identifiers for
validation and registration. The pre-validation
information may be transmitted from MTSO 20 to
clearinghouse 22 over data link 23. Likewise, platform
25   24 may perform the pre-validation without resort to an
outside clearinghouse, over link 32. With pre-call
validation performed by clearinghouse 22, later data
messages can be sent directly to platform 24 over
link 32. It should be understood that link 32 may be the
30   same as voice/data link 21, a separate dedicated data
link, or another communications link.
Data link 34 between platform 24 to platform 25
allows distributed platforms to exchange information
regarding user validation, fraud management, systems

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operation, and billing functions. The distributed
platform embodiment also provides fault tolerant and
traffic management features in network 10, not unlike
those features found in conventional long-distance
5   telephone systems. Thus, as is shown in FIGURE 1,
telecommunications platforms may be centrally located or
arranged in a distributed manner and connected by data
link 34.

        Throughout this description of the invention, host
10   26, platform 24, clearinghouse 22, MTSO 20, and cellular
system 14 have been discussed as separate elements. It
should be understood that each of these components are
logical components, and they may be combined without
physical separation. For example, the functions of
15   platform 24 and host 26 may be accomplished at a single
site. Furthermore, the functions of platform 24 and
clearinghouse 22 may also be accomplished at a single
site. References to cellular system 14, MTSO 20,
clearinghouse 22, platform 24, and host 26 are to be
20   understood as also referring to any cellular system,
switch, clearinghouse, platform, and host, respectively,
of network 10.

        Also illustrated in FIGURE 1 is data link 36, which
allows for data transfer between MTSOs of the cellular
25   systems in network 10. Such a link may be an SS7
backbone link for linking cellular systems. Link 36
allows cellular systems to share information relating to
validation, roaming, billing, call routing, and other
functions performed by network 10. For example, one
30   cellular system that knows the location of a particular
cellular transceiver, such as the cellular transceiver in
messaging unit 16, may share that information with other
cellular systems. Platform 24 may tie into link 36

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across link 21 or link 32 to access information exchanged
among MTSOs of the cellular systems in network 10.

The description of FIGURE 1 references both data
links and voice/data links. Data links, such as links
5   23, 27, 31, 34, and 36, allow transmission of data over a
dedicated data channel. Voice/data links, such as links
21 and 29, support transmission of voice over a voice
channel and transmission of data over a data channel.
For example, a cellular telephone transmission over a
10   voice/data link, such as a T1 transmission link, may
employ digital transmission techniques to carry voice
over a voice channel and data over a data channel, such
as an overhead message stream. It should be understood
that the invention contemplates any transmission
15   technique over a voice/data link, whether digital or
analog, that provides a voice channel and a data channel.
Current systems used in the industry include the DS-1
standard used in the United States and the CCITT primary
multiplex standard used in European telecommunication
20   systems.

Another communications protocol contemplated by the
invention, termed cellular digital packet data (CDPD),
sends data in packets interspersed between voice
transmissions. The data messages in this protocol may be
25   carried in a reserved section of the digital bit stream
or selectively placed to fill unoccupied sections of the
digital bit stream. CDPD technology also supports
delivery of data messages that is not real-time. This is
accomplished by establishing delivery addresses, so a
30   user may receive and store data messages at a designated
address and retrieve the data messages at a later time
for processing.

Voice/data links also support transmission of data
over a voice channel using a modem, dual-tone

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multifrequency ("DTMF") tones, or other suitable data
encoder. The invention contemplates two ways to send a
data message in network 10, data transmission over a data
channel and data transmission over a voice channel using

5   a data encoder. It should be understood that a dedicated
data channel, such as link 34, could be replaced with a
link that also allows voice transmission, without
departing from the intended scope of the present
invention.

10   In operation, network 10 allows data messages to be
sent across cellular systems, such as cellular systems 14
and 30, in a variety of ways. Data messages sent to or
received from messaging units 16 over a voice channel in
network 10 must pass through platform 24 or 25, where

15   they are subject to a handshake protocol to minimize
cellular telephone fraud and maintain secured
communications.

Data messages may also be sent to or received from
messaging unit 16 over a data channel in network 10. As

20   described below, these messages are packaged and sent
over a data channel as part of the call data processing
procedures. Like data messages sent over a voice channel
of network 10, data messages sent over a data channel may
also be subject to a security protocol. Each type of

25   data messaging supported by network 10 will be discussed
in detail with reference to FIGURES 3 and 4.

FIGURE 2 is a block diagram of a messaging unit 16
operating within network 10 of FIGURE 1. In one

30   embodiment of the invention, messaging unit 16 may be
attached to truck trailer 12. However, it should be
understood that data messaging in network 10 is not
limited to truck trailer monitoring systems. Messaging
unit 16 may be attached to any mobile items to be

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monitored, such as people, vehicles, or cargo containers.

As shown in FIGURE 2, cellular transceiver 38 is
coupled to cellular transceiver bus 40. Cellular
transceiver 38 receives and transmits signals across

5   cellular antenna 42, including cellular transmission and
reception of voice and data over the voice and data
channels in network 10. Cellular transceiver 38 may be
just a cellular transmitter equipped to transmit data
messages or just a receiver equipped to receive data

10   messages. It should be understood that further
references to cellular transceiver 38 contemplate a
transmitter, a receiver, or both.

Cellular transceiver bus 40 is coupled to one or
more processors 44 through cellular interface drivers 46.

15   Cellular interface drivers 46 provide the necessary
protocol for communications between processor 44 and
cellular transceiver 38.

A modem 48 allows processor 44 to receive and
transmit digital communication over a voice channel in

20   network 10, as received from and transmitted through
cellular antenna 42 and cellular transceiver 38. Modem
48, or any suitable device, distinguishes between voice
and data encoded on the voice channel, and handles the
information accordingly.

25   Processor 44 is also coupled to a DTMF recognizer
50. DTMF recognizer 50 allows reception and transmission
of DTMF data over a voice channel of network 10, as
received from and transmitted through cellular antenna 42
and cellular transceiver 38. All data transmissions to

30   or from messaging unit 16 can be made using DTMF data.

Processor 44 is also coupled to a read-only memory
("ROM") 52 and a random access memory ("RAM") 54. These
memories are for storage of instructions and data for
operation of processor 44. It should be understood that

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the invention contemplates use of any other suitable
storage devices (not shown) including, but not limited
to, hard disk and floppy disk drives, optical disk
drives, CD-ROM storage devices, tape backups, and plug-in
5   memory modules.   A real-time clock 56 provides processor
44 with time-of-day, day-of-week, month, or year
information.

Messaging unit 16 allows for input of location
information from a LORAN-C system, global positioning
10   satellite (GPS) system, dead reckoning system, inertial
navigation system, or any suitable system providing
location information.   A positioning system interface 58
provides location information to processor 44, as
received from positioning system transceiver 60 through
15   positioning system antenna 62.   The location information
sent to processor 44 from the positioning system can be
either raw location data (for example, data directly
received from a LORAN-C system) or processed location
data.   Therefore, the processing of raw location data can
20   occur within the positioning system itself, within the
positioning system interface 58, within processor 44, or
transmitted through cellular transceiver 38 and cellular
antenna 42 for later processing at platform 24 or host 26
of FIGURE 1.

25   Messaging unit 16 also allows for input of status
information through sensor system 64.   In one embodiment,
sensor system 64 comprises sensors, controllers, and
processors used to monitor various parameters of truck
trailer 12, and operates to pass status information to
30   processor 44.   Sensor system 64 may monitor performance
parameters of truck trailer 12, such as the temperature
of a refrigerated compartment, battery voltage levels, or
diagnostics of other truck trailer subsystems.   Sensor
system 64 may also monitor the status of truck trailer 12

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and its contents, such as whether truck trailer 12 is
connected to a cab and whether the contents have been
tampered with. For purposes of this description,
"sensor" refers to any device that furnishes processor 44
5   with location and status information, including a
positioning system.

A power supply 66 powers the various components of
messaging unit 16. For clarity, the power connections to
the different components of messaging unit 16 are not
10   shown. Power supply 66 is a power management system
which may include a battery and charging circuitry. In
addition, power supply 66 may include optional sources of
power, such as an external power connection 68 from, for
example, a truck electrical system interconnection cable
15   or a solar cell 70 mounted on the roof of truck
trailer 12.

As shown in the particular embodiment of FIGURE 2,
solar cell 70, cellular antenna 42, and positioning
system antenna 62 may be mounted directly on the truck
20   trailer roof, while the other components of messaging
unit 16 reside inside the cargo compartment. However, it
should be understood that the invention contemplates any
arrangement and placement of the components of messaging
unit 16 in one or more separate housings attached to the
25   mobile item to be monitored.

In operation, messaging unit 16 generates a data
message to be sent over voice or data channels of
network 10 upon the occurrence of a reporting event. The
occurrence of a reporting event is determined by
30   processor 44 executing a reporting event determination
module 72, shown as a part of processor 44 in FIGURE 2.
Upon the occurrence of a reporting event, processor 44
may immediately generate and transmit a data message or
generate and store the data message for later

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transmission. By storing data messages, messaging unit
16 may then send a batch of data messages chronicling the
status of truck trailer 12 over a period of time.

One reporting event that may trigger generation of a
5   data message is a time-out signal received by processor
44 from real-time clock 56. Therefore, messaging unit 16
may generate data messages and report location and status
information for truck trailer 12 at a particular time
interval, such as twice a day, every day, or every week.
10 In addition, a reporting event may be an external request
from a variety of sources, such as MTSO 20, clearinghouse
22, platform 24 and host 26, among others.

A reporting event may also be initiated by the truck
trailer transportation equipment or its operator. For
15 example, messaging unit 16 may generate and transmit a
data message upon a signal, received by processor 44 from
sensor system 64, indicating connection or disconnection
from the cab. An operator of the transportation
equipment may also manually request messaging unit 16 to
20 send a data message.

A reporting event may occur in response to a
performance or alarm signal received by sensor system 64
that is beyond predetermined limits. For example, a
reporting event may be when the cargo temperature in a
25 refrigerated truck trailer exceeds a certain minimum or
maximum level. The predetermined limits that trigger a
reporting event may be remotely configured from the
clearinghouse 22, platform 24, or host 26. Processor 44
may also determine a reporting event upon improper access
30 to the cargo hold, malfunctioning of truck trailer
subsystems, or malfunctioning of messaging unit 16
itself.

Furthermore, a reporting event may be based on
geographical information. For example, messaging unit 16

may generate a data message when the truck trailer
location determined by the positioning system deviates
from an expected truck trailer location. The expected
location may be stored in memory such as ROM 52, RAM 54,

5   or other storage device, computed by processor 44, or
received from host 26 or platform 24.

In a similar manner, a reporting event may occur
when truck trailer 12 approaches or crosses a city,
state, or national border, or enters the service area of

10   a cellular system. Therefore, processor 44 executing
reporting event determination module 72 causes messaging
unit 16 to generate a data message upon the occurrence of
a reporting event. The reporting event may be based on
time, external requests, sensor inputs, manual requests

15   by the driver, geographical information, or any other
event or condition that warrants reporting of a data
message to host 26.

Upon determination of a reporting event, messaging
unit 16 operates to transmit and receive a variety of

20   data messages over network 10. The data messages may
contain information that initiated the reporting event,
such as a signal indicating connection of the truck
trailer to a cab, and also other monitored information,
such as the location of the truck trailer at the time of

25   the reporting event. Ultimately data messages
transmitted from messaging unit 16 are routed through
platform 24, clearinghouse 22, or both and accessed by
host 26, as shown in FIGURE 1. A data message may be
communicated over network 10 using either a voice channel

30   or a data channel.

Messaging unit 16, through control of processor 44
may transmit and receive data messages over a voice
channel through platform 24. For clarity, the
transmission or reception of data messages over a voice

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channel, including handshaking, will be discussed in
connection with modem transfers, it being understood that
such transmissions can be made using DTMF tones or other
data encoded on the voice channel.

5   The ability to require that all data messages
communicated over a voice channel pass through platform
24 is an important advantage of the invention, and allows
for modem handshaking between platform 24 and messaging
unit 16. As shown in FIGURE 2, processor 44 runs
10   instructions that execute a handshake protocol module 74
which establishes secure data modem communication with
platform 24. The method to transmit data messages over a
voice channel is described in more detail with reference
to FIGURE 3.

15   Processor 44 also executes a MIN statusing module 76
and a feature request generation module 78, which allow
messaging unit 16 to generate and transmit data messages
over a data channel of network 10. As described below
with reference to FIGURE 4, MIN statusing module 76
20   allows messaging unit 16 to encode status and location
information by altering identifiers of cellular
transceiver 38, such as the mobile identification number
(MIN) or electronic serial number (ESN), transmitted over
a data channel of network 10. Feature request generation
25   module 78, also discussed with reference to FIGURE 4, is
another method to send data messages over a data channel
by appending to a feature request data digits
representing status and location information.

        Link 80 between processor 44 and the transportation
30   system allows messaging unit 16 to send and receive
communications to and from, for example, a truck cab.
The link may allow two-way communications using a short
range radio system, an infra-red (IR) coupling, a direct
connection through signal wires, or other appropriate

technology. Alternatively, the link may be a one-way
communications link that allows messaging unit 16 to send
data messages for transmission by the transportation
system. In one embodiment, a one-way link may allow a
5   scanner attached to the transportation system to identify
the attached truck trailer 12.

Functionally, link 80 allows components of messaging
unit 16 to be divided between the mobile item and its
transportation system. In one embodiment, processor 44
10   residing on the mobile item generates a data message and
then sends this data message over link 80 for
transmission by cellular transceiver 38 located on the
transportation system. In such a manner, the cost of
outfitting mobile items with data messaging capabilities
15   may be reduced by placing components of messaging unit 16
on the transportation system. It should be understood
that the invention contemplates any arrangement of
components of messaging unit 16 on the mobile item and
the transportation system.
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FIGURE 3 is a flow diagram for sending a data
message generated by messaging unit 16 over a voice
channel of network 10 using a modem handshake protocol.
The method begins at block 100 which determines whether
25   one of a variety of reporting events has occurred, as
determined by processor 44 running reporting event
determination module 72. If no reporting event has
occurred, the method loops back in a continuous fashion
to monitor the existence of a reporting event. When a
30   reporting event occurs, block 102 generates a data
message. The data message may contain location and
status information of truck trailer 12 in a standard data
package for transmission by modem 48. It should be
understood that the invention contemplates any suitable

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modem transfer protocol and compression technique to
prepare the data for transmission by modem 48.

The method of FIGURE 3 then proceeds to block 104
where messaging unit 16 establishes a data modem
5   connection with platform 24 over a voice channel of
voice/data link 21 or 32. Data modem connection
establishes the parameters for communication, such as
baud rate, parity, and number of stop bits. After the
connection is established, block 106 initiates a modem
10   handshake between messaging unit 16 and platform 24. The
modem handshaking proceeds in accordance with the
teachings of pending U.S. Patent Application No.
08/095,166 entitled "Method and Apparatus for a Nation-
Wide Cellular Telephone Network," referenced above. If
15   messaging unit 16 does not pass the modem handshake and
establish secure communications with platform 24, the
method proceeds to block 108, where the communication is
disconnected. At block 110, messaging unit 16 may try to
reestablish a data modem connection and retry modem
20   handshaking. Alternatively, the process may be reset for
detection of another reporting event at block 100.

Upon successful modem handshake, the method proceeds
to block 112 where modem 48 downloads the contents of the
data message into a storage device in platform 24. The
25   data may be time-stamped and stored as an entry in a log
of data messages from messaging unit 16. Platform 24 can
also index received data messages by an identification
number of messaging unit 16 or cellular transceiver 38
received during modem handshaking at block 106. At block
30   114, an external device, such as a dispatcher's computer
at host 26, can access the stored data messages and
update a record of the location and status of mobile
items equipped with messaging unit 16.

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FIGURE 4 is a flow diagram for sending a data
message over a data channel of network 10 using either
the MIN statusing 76 or feature request generation 78
5   modules of processor 44. Unlike data messaging using
modem data or DTMF tones, the following discussion
describes transmission of data messages through network
10 without opening a voice channel. Furthermore, the
data messaging techniques described below can be routed
10   through clearinghouse 22, platform 24, or both
clearinghouse 22 and platform 24.

The method of FIGURE 4 begins at block 116 which
determines whether a reporting event has occurred by
executing reporting event determination module 72 in
15   processor 44. If no reporting event has occurred, the
method continues to monitor sensor system 64, real-time
clock 56, location data received from positioning system
interface 58, and other inputs to determine if a
reporting event has occurred.

20   Upon the occurrence of a reporting event, block 118
generates a data message. As described above, data
messages may be created and sent immediately or created
and stored for later transmission by messaging unit 16.
A data message for transmission over a data channel of
25   network 10 may be generated in two ways. First, location
and status information can be encoded by altering
identifiers of cellular transceiver 38, such as the
mobile identification number (MIN) or electronic serial
number (ESN). A second way to generate a data message is
30   by dialing a feature request and appending location and
status information in digits of data within the feature
request. These two different ways of generating a data
message are described in detail below.

The process to alter identifiers of a cellular
transceiver 38 to transmit a data message, termed MIN
statusing, begins with identification of the event to be
reported and a translation of this event into a coded

5   number. For example, assume processor 44 of messaging
unit 16 receives a reporting event signal from sensor
system 64 indicating that the temperature in the
refrigerator compartment of truck trailer 12 is too high.
Processor 44 translates the reporting event into, for

10   example, a two-digit status code "39". The MIN of
cellular transceiver 38 may be altered to include status
code "39" in a designated data field. For example, if
the current MIN is "099 881 1234", then the new altered
MIN with the embedded status code may be "099 880 0039".

15   The prefix "880" indicates that the MIN has been altered
to convey status or location information, and the last
four digits contain the encoded location or status
information in the form of a two-digit status code "39".
The MIN of cellular transceiver 38 is altered to

20   include a data message, but the ESN remains fixed to be
used as an identifier of the messaging unit 16 that sends
the data message. Therefore, upon receipt of the
MIN/ESN, clearinghouse 22 or platform 24 can identify the
messaging unit 16 by the ESN and can also receive status

25   and location information encoded in the MIN.
Alternatively, processor 44 can alter the ESN of cellular
transceiver 38 and keep the MIN constant. It should be
understood that the invention contemplates modification
of the MIN, ESN, both the MIN and ESN, or other

30   identifiers of cellular transceiver 38 to accomplish the
dual task of encoding location or status information and
identifying messaging unit 16.
Cellular transceiver 38 may transmit identifiers to
MTSO 20 upon a call, feature request, pre-call

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validation, or other communication between cellular
transceiver 38 and MTSO 20. Therefore, the MIN statusing
techniques of the invention can be used alone or in
connection with feature request data messaging, data
5   messaging over a voice channel of network 10, or any
other data messaging technique that also transmits
identifiers of cellular transceiver 38.

A second way to generate a data message at block 118
is to use a feature request and append location and
10   status information in designated data digits of the
feature request. Feature requests come in several
varieties. For example, some feature requests are
intercepted and acted upon by MTSO 20, such as "*18" and
"*19" used to establish and disconnect roaming services.
15   Other feature requests, such as programmed speed dial
numbers, are equivalent to dialing a telephone number.

A dedicated feature request intercepted by MTSO 20
may be specifically implemented to transmit data
messages. Such dedicated feature requests allow
20   messaging unit 16 to send detailed data messages
containing, for example, accurate location information
generated by the positioning system. As an example, a
data messaging feature request termed "*71" is generated
by automatically or manually dialing the star key "*", a
25   two-digit feature request identification code "71", and
29 digits of data. Furthermore, cellular transceiver 38
automatically appends the MIN/ESN to a feature request
transmission. Such a feature request generated by
messaging unit 16 and sent over a data channel of the
30   cellular system would allow appended data messages of up
to 29 digits.

Upon generating a data message using either MIN
statusing 76 or feature request generation 78, the method
of FIGURE 4 proceeds to block 120 where MTSO 20 receives

25

the data message. MTSO 20 may directly recognize the
MIN/ESN or feature request identification code as
identifying a data message from messaging unit 16. For
example, MTSO 20 may be directed to recognize and process
5   in a special manner all communications from a particular
predetermined MIN/ESN, such as all MINs beginning with
"099 880". Alternatively, MTSO 20 may be directed to
recognize and process in a special manner all feature
request transmissions with a particular feature request
10   identification code, such as "71".

In another embodiment, MTSO 20 may contain a
separate processor that indirectly monitors the call
transactions through MTSO 20. The separate processor may
also recognize and process data messages from messaging
15   unit 16 in the same manner described above. In either
situation, MTSO 20 appends a mobile serving carrier I.D.
("MSCID") to the MIN/ESN at block 122 and routes the data
message to clearinghouse 22 over data link 23 or platform
24 over voice/data link 21 or 32.

20   In one embodiment, the data message is received
directly at clearinghouse 22, as shown in block 124. In
another embodiment shown in block 126, the data message
is received at platform 24 directly through voice/data
links 21 or 32, or indirectly through data link 27 from
25   clearinghouse 22. An optional security protocol is
performed at block 127 to ensure the authenticity of the
data message. At block 128, the method identifies the
particular messaging unit 16 that is reporting the data
message using the MIN/ESN or other identifiers of
30   cellular transceiver 38 or messaging unit 16. The data
message is then translated or decoded to determine the
status or location information reported by messaging unit
16.

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       The method of FIGURE 4 continues at block 130 where each data message may be time-stamped, indexed by identification number, and stored for later retrieval. The method of FIGURE 4 concludes at block 132, where an

5   external device, such as a dispatcher's computer at host 26, can access the stored data messages and update a record of the location and status of items equipped with messaging unit 16, and thus allow appropriate responses to the data messages.

10   Throughout the discussion of FIGURES 3 and 4, the data messages are transmitted by messaging unit 16 to be collected at a central location, such as clearinghouse 22, platform 24, or host 26. It should be understood that messaging unit 16 equipped with cellular transceiver

15   38 may also receive data messages from a central location. The data messages may be sent from a central location to messaging unit 16 over a voice or data channel of network 10 and in a similar manner as described above with reference to FIGURES 3 and 4. For

20   example, data messages received by messaging unit 16 may be sent over a data channel using MIN statusing or feature request generation, or over a voice channel using a data encoder, such as a modem or DTMF recognizer. Received data messages at messaging unit 16 may serve a

25   variety of functions, such as remotely programming predetermined sensor reporting limits, updating messaging unit 16 software, requesting information, or alerting the operator of the transportation system, among others.

       There have been described certain embodiments of the

30   invention that are capable of data messaging in a communications network. While these embodiments have been described and disclosed, other changes, substitutions, or alterations can be made without

departing from the spirit and scope of the invention, as described in the appended claims.

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WHAT IS CLAIMED IS:

1.   A system for communicating data messages over a cellular telephone network, comprising:

a plurality of messaging units, each messaging unit
5   comprising a processor operable to generate a data message upon the occurrence of a reporting event, each messaging unit further comprising a cellular transmitter operable to transmit the data message over the cellular telephone network;

10   a platform coupled to the cellular telephone network and operable to receive data messages transmitted by the messaging units, the platform further comprising a storage device for storing data messages; and

a host coupled to the platform and operable to
15   access data messages stored by the platform.

2.   The system of Claim 1, wherein each messaging unit further comprises circuitry for generating the data message by encoding an identifier of the cellular
20   transmitter with information on the reporting event.

3.   The system of Claim 1, wherein each messaging unit further comprises circuitry for generating the data message by appending to a feature request data digits
25   representing information on the reporting event.

4.   The system of Claim 1, and further comprising a switch coupled to the platform and operable to recognize data messages, and upon recognition, route data messages
30   to the platform.

5.   The system of Claim 1, wherein the platform further comprises circuitry for identifying the messaging unit that sent a particular data message.

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6.　　The system of Claim 1, wherein each messaging
unit is attached to a trucking trailer located within a
service area of the cellular telephone network.

5　　　　　7.　　The system of Claim 1, wherein the cellular
transmitter is operable to transmit the data message over
a data channel of the cellular telephone network.

8.　　The system of Claim 1, wherein the cellular
10　　　transmitter is operable to transmit the data message over
a voice channel of the cellular telephone network using a
data encoder.

30

9. A messaging unit for sending data messages over
a data channel of a cellular telephone network, the
messaging unit attached to a mobile item to be monitored
comprising:

5   a sensor located on the mobile item and operable to
generate information on the mobile item;
        a processor coupled to the sensor and operable to
receive the information from the sensor, the processor
further operable to generate a data message containing

10   the information upon the occurrence of a reporting event;
and
        a cellular transmitter coupled to the processor and
operable to transmit the data message over a data channel
of the cellular telephone network.

15

        10. The messaging unit of Claim 9, wherein the
sensor is a positioning system that generates location
information of the mobile item.

20   11. The messaging unit of Claim 9, wherein the
sensor is a performance sensor that monitors the
performance of the mobile item.

        12. The messaging unit of Claim 9, wherein the
25   processor further comprises circuitry for generating the
data message by encoding an identifier of the cellular
transmitter with information from the sensor.

        13. The messaging unit of Claim 9, wherein the
30   processor further comprises circuitry for generating the
data message by appending to a feature request data
digits representing information from the sensor.

14.   A method for data messaging over a cellular
telephone network by encoding an identifier of a cellular
transmitter, comprising:
   .initiating data messaging upon the occurrence of a
5   reporting event;
   encoding the identifier of the cellular transmitter
with information on the reporting event;
   transmitting the encoded identifier through the
cellular telephone network using the cellular
10   transmitter; and
   receiving the encoded identifier at a remote
location.

15.   The method of Claim 14, wherein the step of
15   initiating data messaging occurs upon receiving a time-
out signal from a real-time clock.

16.   The method of. Claim 14, wherein the step of
initiating data messaging occurs upon receiving a sensor
20   signal beyond predetermined limits.

17.   The method of Claim 14, wherein the step of
initiating data messaging occurs upon receiving location
information.
25

18.   The method of Claim 14, wherein the step of
initiating data messaging occurs upon receiving a request
to initiate data messaging.

30   19.   The method of Claim 14, wherein the step of
encoding the identifier of the cellular transmitter
comprises encoding the mobile identification number of
the cellular transmitter with information on the
reporting event.

20. The method of Claim 14, wherein the step of encoding the identifier of the cellular transmitter comprises encoding the electronic serial number of the cellular transmitter with information on the reporting event.

21. The method of Claim 14, wherein the step of transmitting the encoded identifier is initiated by dialing a telephone number.

22. The method of Claim 14, wherein the step of transmitting the encoded identifier is initiated by issuing a feature request.

23. The method of Claim 14, wherein the step of transmitting the encoded identifier is performed during pre-call validation communication.

24. The method of Claim 14, and further comprising the following steps performed at the remote location:
    identifying the cellular transmitter transmitting the encoded identifier;
    decoding the encoded identifier into information on the reporting event; and
    storing information on the reporting event indexed by cellular transmitter.

25. The method of Claim 14, wherein the cellular transmitter is located on a truck trailer.

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26. A method for data messaging over a cellular
telephone network by issuing a feature request,
comprising:
       initiating data messaging upon the occurrence of a
5   reporting event;
       generating a feature request;
       appending to the feature request data digits
representing information on the reporting event;
       transmitting the feature request and data digits
10   through the cellular telephone network; and
       receiving the feature request and data digits at a
remote location.

       27. The method of Claim 26, wherein the step of
15   initiating data messaging occurs upon receiving a time-
out signal from a real-time clock.

       28. The method of .Claim 26, wherein the step of
initiating data messaging occurs upon receiving a sensor
20   signal beyond predetermined limits.

       29. The method of Claim 26, wherein the step of
initiating data messaging occurs upon receiving location
information.
25

       30. The method of Claim 26, wherein the step of
initiating data messaging occurs upon receiving a request
to initiate a reporting event.

30   31. The method of Claim 26 wherein the step of
generating a feature request comprises dialing a star key
followed by a two-digit code.

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32. The method of Claim 26, and further comprising
the following steps performed at the remote location:
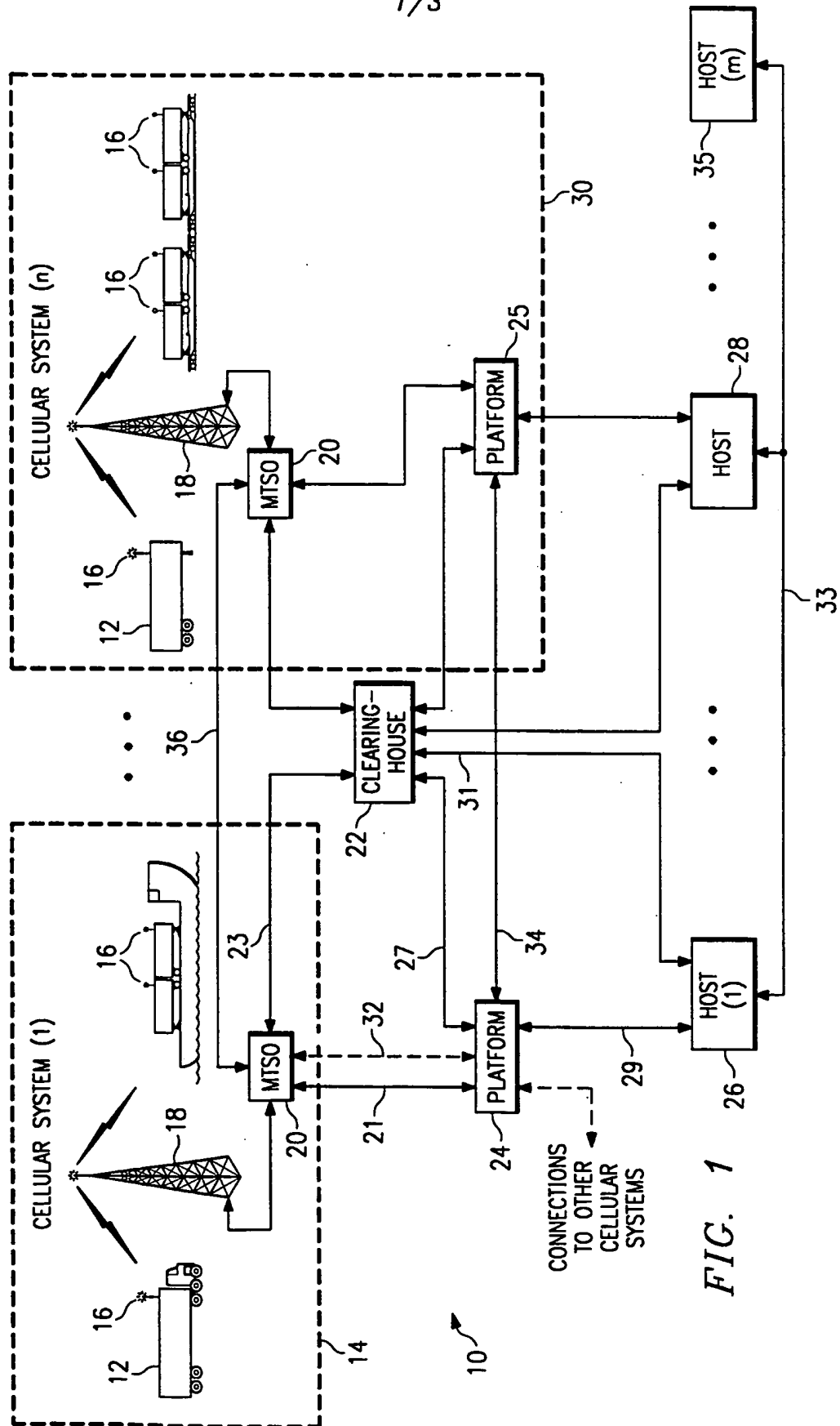   identifying a cellular transmitter transmitting the
feature request and data digits;
5   decoding the data digits into information on the
reporting event; and
    storing information on the reporting event indexed
by cellular transmitter.

10   33. The method of Claim 26, wherein the cellular
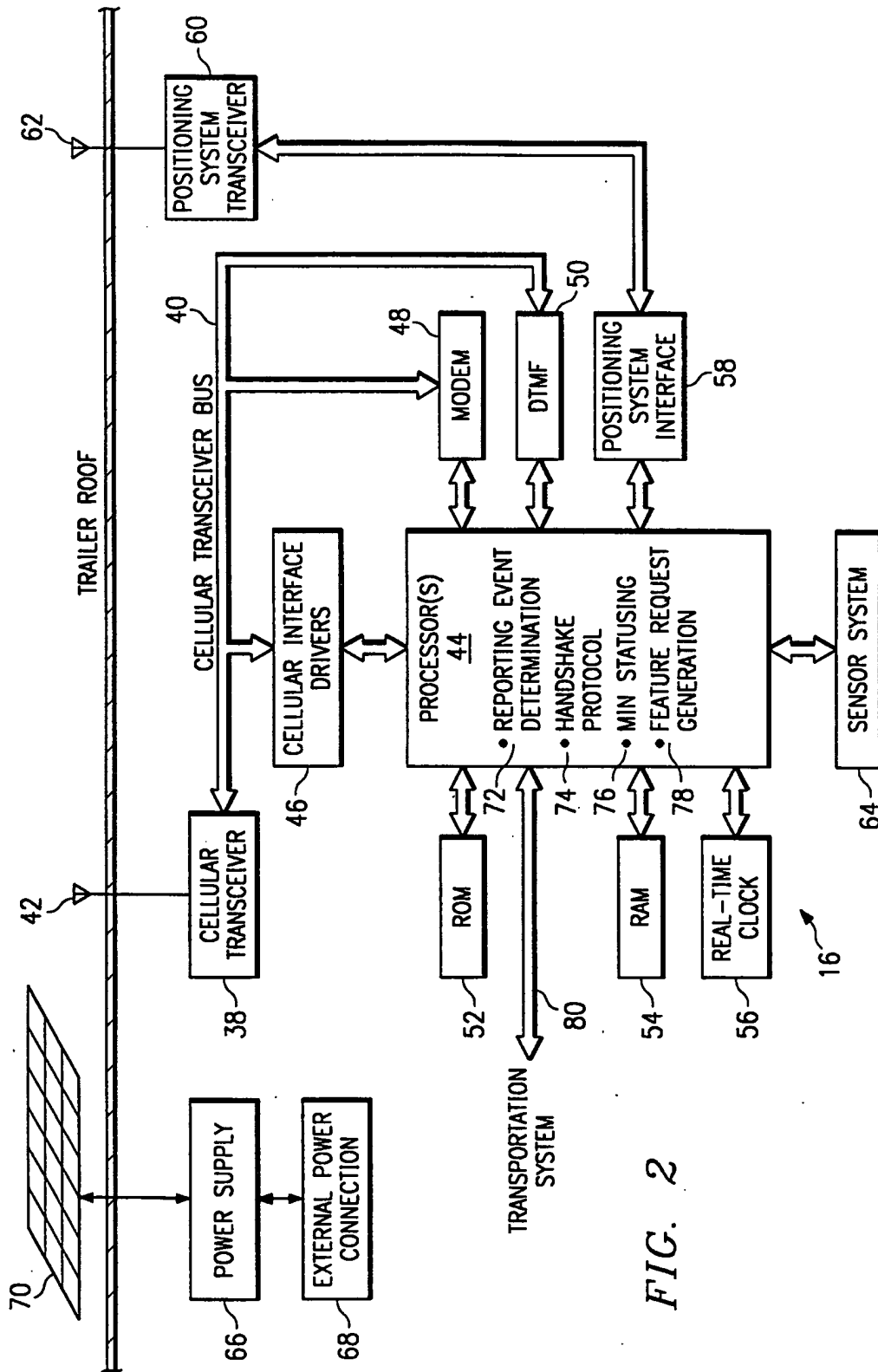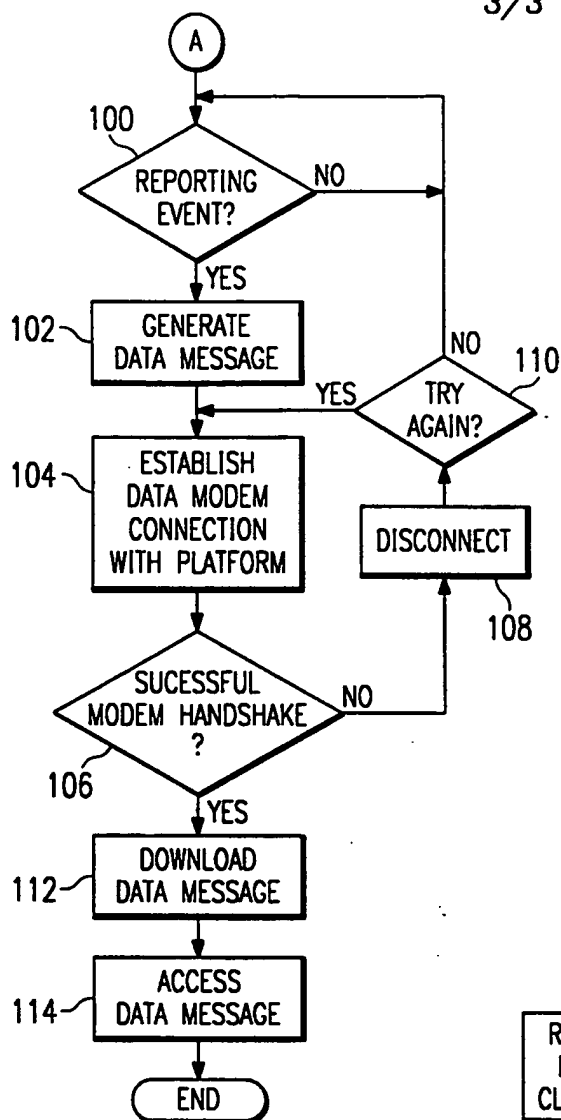transmitter is located on a truck trailer.

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FIG. 1

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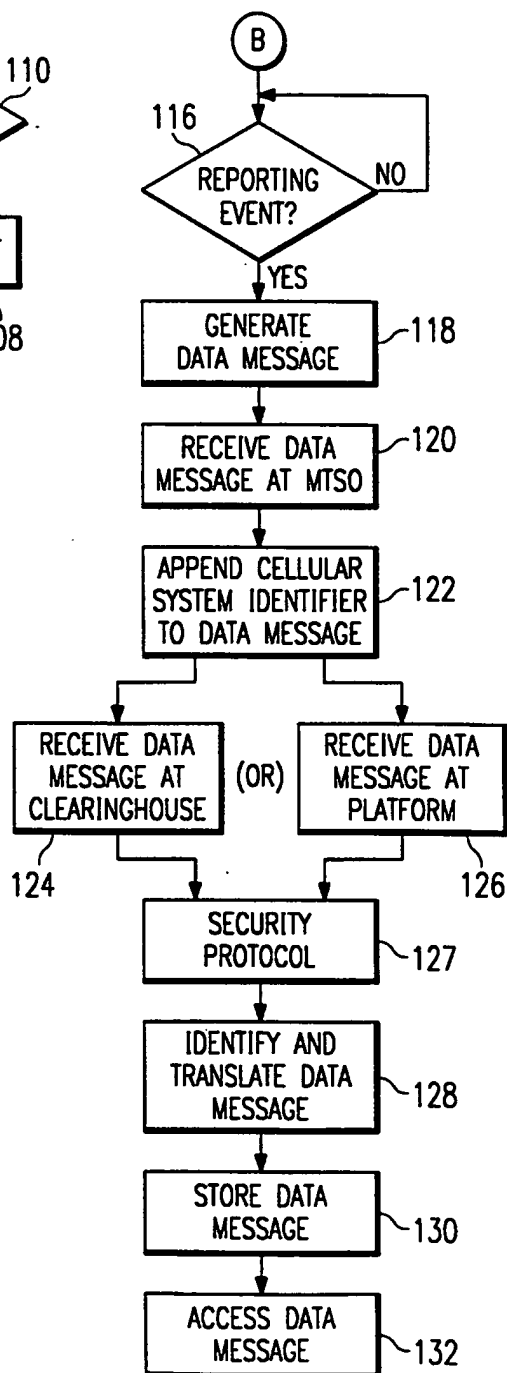

FIG. 2

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```
                    ( A )
                      │
                      ▼
  100              ◇ REPORTING ◇────NO────┐
                   ◇  EVENT?  ◇           │
                      │                   │
                     YES                  │
                      ▼                   │
  102          ┌─────────────┐           │
               │  GENERATE   │           │
               │ DATA MESSAGE│           │
               └─────────────┘           │
                      │          NO  110 │
                      ▼        ┌────────┐ │
  104      ┌──────────────┐   ◇  TRY   ◇│
           │  ESTABLISH   │   ◇ AGAIN? ◇│
           │ DATA MODEM   │◄─YES◇      ◇│
           │ CONNECTION   │    └────────┘│
           │ WITH PLATFORM│        ▲     │
           └──────────────┘   ┌─────────┐│
                  │           │DISCONNECT││
                  ▼           └─────────┘│
           ◇ SUCESSFUL ◇          ▲  108 │
           ◇MODEM HAND ◇──NO──────┘      │
           ◇ SHAKE ?   ◇                 │
  106         │                          │
             YES                         │
              ▼                          │
  112   ┌─────────────┐                  │
        │  DOWNLOAD   │                  │
        │ DATA MESSAGE│                  │
        └─────────────┘                  │
              │                          │
              ▼                          │
  114   ┌─────────────┐                  │
        │   ACCESS    │                  │
        │ DATA MESSAGE│                  │
        └─────────────┘                  │
              │                          │
              ▼                          │
          ( END )                        │
```

FIG. 3

```
                    ( B )
                      │
  116                 ▼
        ◇ REPORTING ◇────NO───┐
        ◇  EVENT?  ◇          │
              │               │
             YES              │
              ▼               │
  118  ┌─────────────┐
       │  GENERATE   │
       │ DATA MESSAGE│
       └─────────────┘
              │
              ▼
  120  ┌─────────────┐
       │ RECEIVE DATA│
       │MESSAGE AT MTSO│
       └─────────────┘
              │
              ▼
  122  ┌──────────────┐
       │APPEND CELLULAR│
       │SYSTEM IDENTIFIER│
       │TO DATA MESSAGE│
       └──────────────┘
          │         │
          ▼         ▼
  ┌──────────┐  ┌──────────┐
  │RECEIVE DATA│(OR)│RECEIVE DATA│
  │MESSAGE AT │  │MESSAGE AT │
  │CLEARINGHOUSE│ │ PLATFORM │
  └──────────┘  └──────────┘
    124  │         │  126
         ▼         ▼
       ┌─────────────┐
       │  SECURITY   │
       │  PROTOCOL   │ 127
       └─────────────┘
              │
              ▼
       ┌─────────────┐
       │ IDENTIFY AND│
       │TRANSLATE DATA│ 128
       │   MESSAGE   │
       └─────────────┘
              │
              ▼
       ┌─────────────┐
       │ STORE DATA  │
       │   MESSAGE   │ 130
       └─────────────┘
              │
              ▼
       ┌─────────────┐
       │ ACCESS DATA │
       │   MESSAGE   │ 132
       └─────────────┘
```

FIG. 4

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5)   :IPC(5): H04M 11/00
US CL   :379/59

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. :   379/59,58; 455/33.1; 340/425.5, 426, 431, 531, 539

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 4,750,197 (DENEKAMP et al.) 07 June 1988, see col. 5, line 55 to col. 12, line 30.	1, 4-6, 8 -------- 2, 3, 7, 9-33
X -- Y	US, A, 4,688,244 (HANNON et al.) 18 August 1987, see col. 5, line 30 to col. 10, line 64.	1, 4-6, 8 ----- 2, 3, 7, 9-33
Y	US, A, 4,897,642 (DILULLO et al.) 30 January 1990, see col. 1, line 63 to col. 4, line 2.	1-33

☐ Further documents are listed in the continuation of Box C.   ☐   See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		
		"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 SEPTEMBER 1994	OCT 27 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer GEORGE OHELING
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